PATENT ABSTRACTS OF JAPAN

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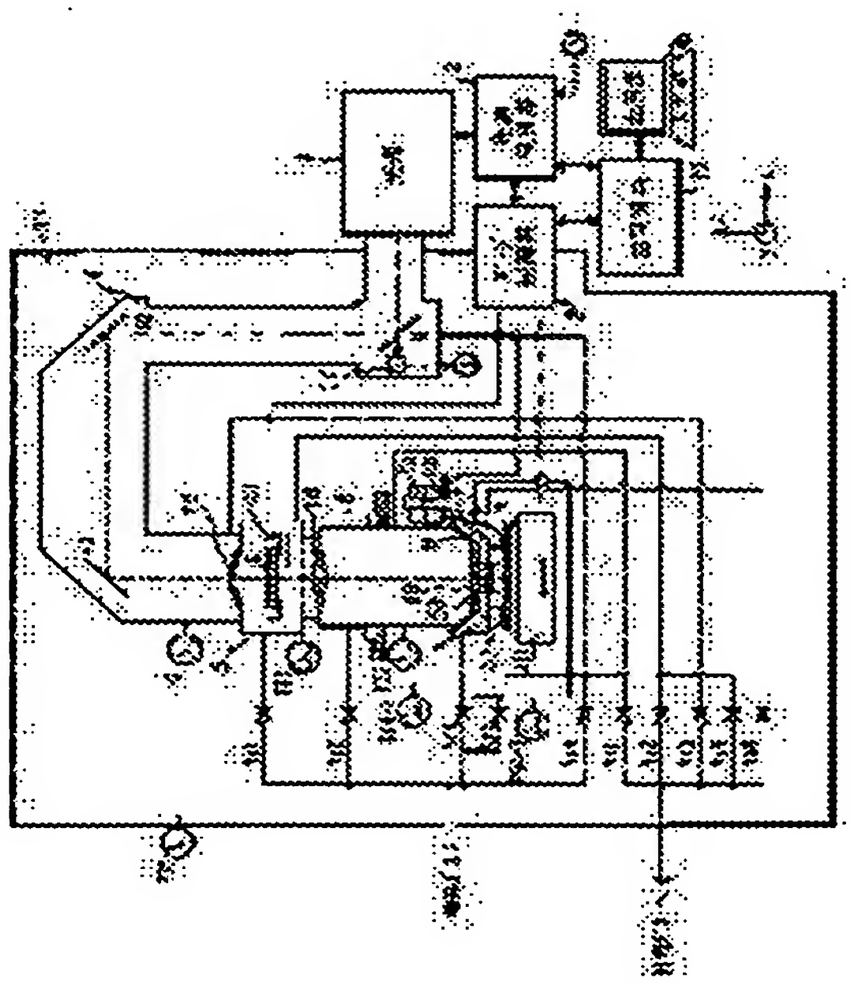
(54) ALIGNER

(57)Abstract:
PROBLEM TO BE SOLVED: To suppress a decrease in strength of an exposure light between a projection optical system and a photosensitive substrate, and to suppress the nonuniformity of impurity concentration therebetween to the minimum.
SOLUTION: A shielding member 9 for shielding almost the entire region of an optical path of an exposure light between a projection optical system 6 and the vicinity of a wafer W from an external atmosphere is provided in a space between the system 6 and the wafer W. The member 9 is mounted on the system 6, and is provided with driving mechanisms 8a and 8b capable of driving the system 6 in a horizontal direction of the wafer W and driving mechanisms 9a and 9b capable of driving the system 6 in a vertical direction of the wafer W.



LEGAL STATUS

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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The aligner characterized by horizontal and to form a vertical movable drive in said covered member at least to said optical member at either in the aligner which has the covered member which is the aligner which imprints the projection image of a mask pattern to a photosensitive substrate by exposure light, encloses the optical member circumference arranged by the optical path of said exposure light, permutes the ambient atmosphere of the optical member circumference concerned by the high-concentration gas, and is held to predetermined concentration.
[Claim 2] Said covered member is an aligner according to claim 1 characterized by being prepared so that the optical member circumference arranged by the outgoing radiation part of the exposure light from the projection optical system concerned to said photosensitive substrate may be surrounded, including further the projection optical system which forms the optical path of the exposure light which projected said mask pattern.
[Claim 3] Said covered member is an aligner according to claim 1 or 2 characterized by being prepared so that the optical member circumference arranged by the incidence part of the exposure light to the projection optical system concerned may be surrounded, including further the projection optical system which forms the optical path of the exposure light which projected said mask pattern.
[Claim 4] Said covered member is an aligner according to claim 2 or 3 characterized by being prepared so that the optical member circumference arranged by the outgoing radiation part of the illumination light to the mask held at the illumination-light study system concerned may be surrounded, including further the illumination-light study system which forms the optical path of the illumination light which is prepared in the preceding paragraph of said projection optical system, illuminates a mask pattern, and generates a projection image.
[Claim 5] Said covered member is an aligner given in claim 1 characterized by having the feed zone which supplies inert gas around said optical member, and the blowdown section which discharges the inert gas supplied from said feed zone thru/or any 1 term of 4.
[Claim 6] Said covered member is an aligner given in claim 1 characterized by having the transparence member which penetrates exposure light thru/or any 1 term of 5.
[Claim 7] Said covered member is an aligner given in claim 1 characterized by spraying inert gas between covered members and said photosensitive substrates concerned thru/or any 1 term of 6.
[Claim 8] Said covered member is an aligner given in claim 1 characterized by spraying inert gas between covered members and said masks concerned thru/or any 1 term of 6.
[Claim 9] opening which said covered member makes pass inert gas — having — the optical-axis core of said projection optical system — a passage and the optical-axis core concerned — abbreviation — an aligner given in claim 1 characterized by supplying inert gas to said photosensitive substrate from an parallel direction, and said projection optical system carrying out outgoing radiation of the exposure light in the inert gas ambient atmosphere concerned thru/or any 1 term of 7.
[Claim 10] opening which said covered member makes pass inert gas — having — the optical-

axis core of said illumination-light study system — a passage and the optical-axis core concerned — abbreviation — an aligner given in claim 1 characterized by supplying inert gas to said mask from an parallel direction, and said illumination-light study system carrying out outgoing radiation of the illumination light in the inert gas ambient atmosphere concerned thru/or any 1 term of 7.

[Claim 11] Said feed zone is an aligner according to claim 5 characterized by measuring the inert gas flow rate supplied to said covered member, and supplying the inert gas more than a predetermined flow rate.

[Claim 12] An aligner given in claim 1 characterized by having further the pressure regulation section which makes the pressure of the space between said projection optical systems and said covered members higher than the pressure of the space of said photosensitive substrate and said covered member, and supplying inert gas to said photosensitive substrate by the set-up pressure concerned thru/or any 1 term of 11.

[Claim 13] An aligner given in claim 1 characterized by having further the pressure regulation section which makes the pressure of the space between said illumination-light study systems and said covered members higher than the pressure of the space of said mask and said covered member, and supplying inert gas to said mask by the set-up pressure concerned thru/or any 1 term of 11.

[Claim 14] The aligner according to claim 12 characterized by having further the exhaust air section which exhausts inert gas from the space of said covered member and said photosensitive substrate, and supplying inert gas to said photosensitive substrate in the condition that the pressure of the space of the photosensitive substrate and said covered member concerned is lower than the pressure of the space between said projection optical systems and said covered members.

[Claim 15] The aligner according to claim 13 characterized by having further the exhaust air section which exhausts inert gas from the space of said covered member and said mask, and supplying inert gas to said mask in the condition that the pressure of the space of the mask and said covered member concerned is lower than the pressure of the space between said illumination-light study systems and said covered members.

[Claim 16] Said covered member is an aligner given in claim 1 characterized by holding the distance of the covered member and said photosensitive substrate concerned at predetermined distance, and holding the concentration of said inert gas from said projection optical system to the photosensitive substrate concerned to predetermined concentration thru/or any 1 term of 15.

[Claim 17] An aligner given in claim 1 characterized by having further the test section which measures the distance of said covered member and said photosensitive substrate, holding the distance of said covered member and said photosensitive substrate at predetermined distance based on the measurement result of the test section concerned, and performing exposure thru/or any 1 term of 16.

[Claim 18] An aligner given in claim 1 characterized by having further the test section which measures the distance of said covered member and said mask, holding the distance of said covered member and said mask at predetermined distance based on the measurement result of the test section concerned, and performing exposure thru/or any 1 term of 16.

[Claim 19] It is an aligner given in claim 1 characterized by moving horizontally opening of the covered member of said projection optical system along with said photosensitive substrate at the time of said exposure thru/or any 1 term of 18.

[Claim 20] Said covered member is an aligner given in claim 1 characterized by being moved so that the distance from the photosensitive substrate concerned and/or a mask may be made to estrange greatly at the time of exchange of said photosensitive substrate and/or a mask and a maintenance maintenance thru/or any 1 term of 19.

[Claim 21] Said inert gas supplied is an aligner given in claim 1 characterized by being the nitrogen gas or gaseous helium by which temperature control was carried out thru/or any 1 term of 20.

[Claim 22] The manufacture approach of the semiconductor device characterized by having the

process which installs the manufacturing installation group for [various] processes which contains the aligner of a publication in claim 1 thru/or any 1 term of 21 in a semi-conductor plant, and the process which manufactures a semiconductor device by multiple processes using this manufacturing installation group.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the aligner which controls exposure luminous-intensity lowering in detail in the aligner exposed using the light of short wavelength about the aligner used in order to manufacture a semiconductor device, an image sensor, a liquid crystal display component, the thin film magnetic head, and other micro devices.
[0002]
[Description of the Prior Art] In the photolithography process for manufacturing a semiconductor device etc., the aligner which exposes the pattern image of photograph reticle (reticle ****) on a photosensitive substrate through a projection optical system is used. In recent years, in the direction of detailed-izing, development progresses and, as for the semiconductor integrated circuit, short wavelength-ization of the photolithography light source is progressing in the photolithography process.
[0003] However, when light, such as higher harmonics, such as vacuum ultraviolet radiation and the light of wavelength shorter than especially 250nm, for example, KrF excimer laser, (wavelength of 248nm), ArF excimer laser (wavelength of 193nm), F2 laser (wavelength of 157nm), or an YAG laser, was used as an exposure light, the technical problem of luminous intensity falling had arisen under the effect of absorption by oxygen etc.
[0004] So, in the former, in the aligner which has the light source like F2 excimer laser, internal gas tended to be permuted by the gas which covers only an optical-path part, for example, does not contain oxygen like nitrogen, and it was going to avoid decline in the permeability of light.
[0005]
[Problem(s) to be Solved by the Invention] However, moving part, such as a wafer stage and a reticle stage, is difficult with the equipment which exists in an optical path like the so-called aligner of a step-and-repeat (one-shot exposure is repeated for every step) method in electric shielding of only an optical-path part, and it was not avoided that exposure light is selectively put to air.
[0006] Moreover, without surrounding the stage of a photosensitive substrate with a container Also in the aligner which can be exposed in the necessary inert gas ambient atmosphere formed by supplying inert gas to the space between the optical members and the photosensitive substrates which were arranged by the outgoing radiation part of the exposure light from a projection optical system to a photosensitive substrate In order to supply inert gas from the circumference of an exposure field, uniform exposure was difficult because concentration distribution of inert gas becomes an ununiformity on the outskirts of an exposure core and the permeability of the ambient atmosphere of an exposure field becomes an ununiformity. Moreover, attaching the feed zone which supplies inert gas between the optical member of the above-mentioned projection optical system and a photosensitive substrate made difficult the maintenance service in the space from an optical member to a sensitive substrate.
[0007] It is offering the aligner which this invention's can be made in view of the above-mentioned technical problem, and the object's can control the exposure luminous-intensity lowering in the optical member circumference arranged by the optical path of exposure light in

the aligner exposed using the light of short wavelength, can suppress the heterogeneity of the concentration distribution to minimum, and can make easy the maintenance service of the space of an optical member, a photosensitive substrate, or a mask.
[0008]
[Means for Solving the Problem] In order to solve an above-mentioned technical problem and to attain the object, the aligner of this invention It is the aligner which imprints the projection image of a mask pattern to a photosensitive substrate by exposure light. In the aligner which has the covered member which encloses the optical member circumference arranged by the optical path of said exposure light, permutes the ambient atmosphere of the optical member circumference concerned by the high-concentration gas, and is held to predetermined concentration The movable drive of horizontal and a perpendicular direction was formed in either at least to said optical member at said covered member.
[0009]
[Embodiment of the Invention] Below, the gestalt of operation concerning this invention is explained with reference to an accompanying drawing at a detail.
[1st operation gestalt] drawing 1 is the whole aligner block diagram of the 1st operation gestalt concerning this invention, and drawing 2 is the sectional view showing the circumference of the projection optical system shown in drawing 1 , a covered member, and a photosensitive substrate.
[0010] The aligner shown in drawing 1 is equipped with the light source 1 which injects a short wavelength laser beam like F2 excimer laser.
[0011] A part of light beam emitted from the light source 1 penetrates a beam splitter M1, and the quantity of light is measured with the light exposure detector 14. The light source control system 2 performs light control of the light source 1 based on the measurement result of the light exposure detector 14. It is reflected by mirrors M2 and M3, and the light beam reflected by the beam splitter M1 illuminates Reticle R to homogeneity through the suitable optical member 15. The optical path from the light source 1 to Reticle R constitutes the illumination-light study system 4. The light which penetrated Reticle R reaches on the front face of the wafer W laid in the wafer stage WST through the various optical members 10 and 16 which constitute a projection optical system 6, and carries out image formation of the pattern on Reticle R.
[0012] Wafer W is laid in the direction of a three dimension (the XYZ direction) on the movable wafer stage WST, and stepping migration is carried out. And stepping migration and exposure are performed repeatedly, Wafer W is the so-called step-and-repeat method, and projection exposure of the pattern of Reticle R is serially carried out on Wafer W.
[0013] A main control system controls migration of the light source 1 and the XY direction of the wafer stage WST, migration of a reticle stage RST, etc. in generalization.
[0014] The optical path of the exposure light to the optical member 10 which carries out outgoing radiation of the exposure light of a projection optical system 6 to Wafer W from the light source 1 is covered by the covered member 5, the inert gas by which temperature control was carried out through bulbs Vn1, Vn2, and Vn3, for example, nitrogen gas, is supplied, and the illumination-light study system 4, the covered member 5, and a projection optical system 6 are exhausted by bulbs Vo1, Vo2, and Vo3.
[0015] The covered member 9 of the optical path of the exposure light of a up to [from a projection optical system 6] near the wafer W which covers the whole region from an external ambient atmosphere mostly is formed in the space between a projection optical system 6 and Wafer W.
[0016] As a projection optical system is expanded and shown in drawing 2 , the covered member 9 is attached in a projection optical system 6, and the drive 7 which can be driven to Drives 8a and 8b and the perpendicular direction which can be driven to the horizontal direction of Wafer W is formed. Moreover, the amount of [of the covered member 9 and a projection optical system 6] joint considers as the structure where the condition that the covered member 9 and the projection optical system 6 stuck is maintainable, even if it is joined with bellows-like components and the physical relationship changes.
[0017] The covered member 9 has glass 50 for passing exposure light. Moreover, the nitrogen

gas by which temperature control was carried out through the bulb Vn4 is supplied to the space enclosed by the covered member 9. The pressure of the covered space is measured with a pressure gage PG 4-2. The nitrogen gas supplied through Vn4 fills the covered member 9 interior, and is exhausted through a bulb Vo4.

[0018] The nitrogen gas by which temperature control was carried out is supplied between the covered member 9 and the Wth page of a wafer through a bulb Vn5. The supplied nitrogen gas is exhausted through a bulb Vo5. At this time, the pressure of the nitrogen gas supplied by the bulb Vo5 is measured by the pressure system PG 4-1, and the pressure in the container 30 which stores an aligner is measured with a pressure gage PG 5. Usually, it is adjusted so that the value of PG 4-1 may be set to five or more PGes.

[0019] It drives to horizontal and a perpendicular direction with the drives 7, 8a, and 8b attached in the covered member 9. It is made to estrange from Wafer W by driving the covered member 9 to a Z-axis plus direction at the time of wafer exchange or a maintenance maintenance, and wafer exchange and a maintenance maintenance activity are done easy. And at the times of exposure initiation, such as after wafer exchange, the supply of nitrogen gas by which temperature control was first carried out through the bulb Vn4 in the condition, i.e., the condition of having made as narrow as possible space surrounded by the covered member 9 and the projection optical system 6, of having moved the covered member to the Z-axis plus direction is started. It is possible to make into high concentration by this inert gas concentration of the space surrounded by the covered member 9 and the projection optical system 6 for a short time. Next, the covered member 9 is driven in the Z-axis minus direction from Wafer W to the location of predetermined height, maintaining a predetermined pressure, and it exposes, performing alignment of Wafer W and Reticle R. In this case, it is possible to suppress lowering of the inert gas concentration of the exposure field by the ambient atmosphere from the circumference of a projection optical system 6 invading, and to acquire uniform concentration distribution by arranging the distance between the covered member 9 and Wafer W to 1mm. Moreover, it is possible to acquire more uniform concentration distribution by exposing measuring the distance between the covered member 9 and Wafer W, and keeping a distance in the meantime constant synchronizing with the wafer stage WST and a reticle stage RST.

[2nd operation gestalt] drawing 3 thru/or drawing 5 are the enlarged drawings of the projection optical system in the aligner of the 2nd operation gestalt concerning this invention.

[0020] With the 1st operation gestalt, the glass 50 which penetrates exposure light was used for the covered member 9, by supplying the nitrogen gas by which temperature control was carried out to the space between Wafer W and glass 50, lowering of the nitrogen gas concentration of an exposure field was able to be suppressed, and uniform concentration distribution was able to be acquired.

[0021] As the 2nd operation gestalt shows to drawing 3 thru/or drawing 5 , while forming opening 20 in the part which counters the wafer W of the covered member 9 attached in the projection optical system 6 and passing exposure light from opening 20 to this 1st operation gestalt, by supplying the nitrogen gas by which temperature control was carried out to Wafer W from that opening 20, lowering of the nitrogen gas concentration of an exposure field is suppressed, and uniform concentration distribution is acquired.

[0022] It drives to horizontal and a perpendicular direction like the 1st operation gestalt with the drives 7a, 7b, 8a, and 8b attached in the covered member 9. It is made to estrange from Wafer W by driving the covered member 9 to a Z-axis plus direction at the time of wafer exchange or a maintenance maintenance, and wafer exchange and a maintenance maintenance activity are done easy. And at the times of exposure initiation, such as after wafer exchange, the supply of nitrogen gas by which temperature control was first carried out through the bulb Vn4 in the condition, i.e., the condition of having made as narrow as possible space surrounded by the covered member 9 and the projection optical system 6, of having moved the covered member 9 to the Z-axis plus direction is started. It is possible to make into high concentration by this inert gas concentration of the space surrounded by the covered member 9 and the projection optical system 6 for a short time. Next, it is possible to acquire more uniform concentration distribution by exposing driving the covered member 9 in the Z-axis minus direction from Wafer W to the

location of predetermined height, maintaining a predetermined pressure, measuring the distance between the covered member 9 and Wafer W synchronizing with a wafer stage and a reticle stage, performing alignment of Wafer W and Reticle R, and keeping a distance in the meantime constant.

[0023] Moreover, as shown in drawing 5 , the nitrogen gas supplied between Wafer W and the covered member 9 may be efficiently collected from.opening 20 by establishing an exhaust port 40 for the covered member 9 on the outside of the covered member 9. At this time, it is possible for controlling displacement so that the pressure of PG 4-3 becomes low from the pressure PG 4-2 of the space which measured the pressure of an exhaust port 40 with PG 4-3, and was surrounded by the covered member 9 to also pass opening 20 from the covered member 9, and it to supply nitrogen gas on a wafer side.

[3rd operation gestalt] drawing 6 is drawing showing opening and the lighting region at the time of exposing the circumference of a photosensitive substrate in a scanning aligner.

[0024] Below, it applies to a scanning aligner by making the aligner of this invention into the 3rd operation gestalt, and the actuation approach of the covered member 9 in the case of exposing the circumference of Wafer W is explained.

[0025] As shown in drawing 6 (a), when exposing the circumference of Wafer W, sequential exposure of the field of ** - ** will be carried out. In this case, since the lighting region where the illumination light is irradiated, and the location of opening 20 established in the covered member 9 are arranged so that each core may be in agreement, a part of opening 20 will come out of it to the outside of Wafer W. In this case, the nitrogen gas concentration of the field which is an exposure field and exists on a wafer side is made to fall by the contamination at the time of Wafer W, diffusion of the ambient atmosphere of a surrounding level difference to the circumference, and actuation of a stage. In order for permeability to fall about the part to which nitrogen gas concentration fell, it becomes the lack of the exposure quantity of light, and exposure nonuniformity is produced. Then, it drives, synchronizing the covered member 9 in the direction of y to a wafer stage and a reticle stage along the wafer circumference for opening 20, as shown in drawing 6 (b). Thus, it is possible to be able to arrange opening 20 inside Wafer W by making it drive, to suppress trespass of a surrounding ambient atmosphere from Wafer W and the level difference of the circumference of it, and to attain uniform concentration distribution in larger space.

[0026] That it is the same as that of the above can apply also in the aligner of a step-and-repeat method. Moreover, since the rate of flow of the nitrogen which the way when opening is small spouts from opening becomes large when the consumption of the nitrogen which will make magnitude of opening small in case the circumference of Wafer W is exposed, and is supplied to the interior of a covered member by adding the device in which the magnitude of opening is changed is the same, it becomes possible to suppress degradation of the nitrogen concentration of opening more.

[4th operation gestalt] drawing 7 is the enlarged drawing of the projection optical system in the aligner of the 4th operation gestalt concerning this invention.

[0027] With each above-mentioned operation gestalt, although the reticle R circumference was made into a closed space, in this 4th operation gestalt, the covered members 72 and 73 are used also for a reticle side, opening is prepared in the part which exposure light passes, and the nitrogen gas by which temperature control was carried out from each opening is sprayed toward Reticle R.

[0028] The covered member 72 is attached in the illumination-light study system 71 so that the optical member 77 which illuminates the illumination light of the illumination-light study system 7 may be covered, and the amount of joint makes it into the structure where the condition that the covered member 72 and the illumination-light study system 71 stuck is maintainable, even if it is joined with bellows-like components and the physical relationship changes. Similarly, the covered member 73 is attached in a projection optical system 6 so that the optical member 16 which carries out incidence of the illumination light of the illumination-light study system 71 may be covered, and the amount of joint makes it into the structure where the condition that the covered member 73 and the projection optical system 6 stuck is maintainable, even if it is joined

with bellows-like components and the physical relationship changes.
[0029] To Reticle R, it has the drives 7c, 7d, 8c, and 8d driven perpendicularly, and said covered members 72 and 73 are horizontal and driving in the direction which makes the covered members 72 and 73 estrange from Reticle R at the time of reticle exchange or a maintenance maintenance, and do reticle exchange and a maintenance maintenance activity easy. And at the times of exposure initiation, such as after reticle exchange, the supply of nitrogen gas by which temperature control was carried out is started in the condition, i.e., the condition of having made as narrow as possible space surrounded by the covered member 72 and the illumination-light study system 71, of having moved the covered members 72 and 73 in Z-axis plus or the minus direction first so that it might separate from Reticle R. It is possible to make into high concentration by this inert gas concentration of the space surrounded by the covered member 73 and the illumination-light study system 71 for a short time. Where similarly space surrounded by the covered member 73 and the projection optical system 6 is made as narrow as possible, the supply of nitrogen gas by which temperature control was carried out is started. It is possible to make into high concentration by this inert gas concentration of the space surrounded by the covered member 73 and the projection optical system 6 for a short time. Next, it is possible to acquire more uniform concentration distribution by exposing driving the covered members 72 and 73 even in the location [Reticle / R] of predetermined height, maintaining a predetermined pressure, measuring the distance between the covered members 72 and 73 and Reticle R synchronizing with a wafer stage and a reticle stage, performing alignment of Wafer W and Reticle R, and keeping a distance in the meantime constant.
[0030] With this operation gestalt, the supply pressure of nitrogen gas is measured by PG71 and PG72, and it supplies nitrogen gas so that a predetermined pressure can be maintained. Moreover, although the test section which measures an air supplying opening pressure to a covered member is prepared, it has a flowmeter in an air supplying opening, and nitrogen gas may be supplied on a reticle side from opening by supplying nitrogen gas from an air supplying opening so that the value of a flowmeter may be made regularity. The supplied nitrogen gas is collected from exhaust ports 74 and 75. Moreover, the supplied nitrogen gas may be efficiently collected by attaching an exhaust port so that a covered member may be enclosed, as shown in the 2nd operation gestalt.
[0031] In addition, the gestalt of the operation explained above is an example as an implementation means of this invention, and this invention can apply the above-mentioned operation gestalt also to what corrected or deformed in the range which does not deviate from the meaning.
[0032] Moreover, the aligner of this operation gestalt may prepare and constitute at least one side of the covered member 9 of a projection optical system, and the covered members 72 and 73 of an illumination-light study system.
A [manufacture process], next the manufacture process of a semiconductor device of having used the above-mentioned aligner are explained.
[0033] Drawing 8 shows the flow of the overall manufacture process of a semiconductor device. The circuit design of a semiconductor device is performed at step 1 (circuit design). At step 2 (mask production), a mask is produced based on the designed circuit pattern. On the other hand, at step 3 (wafer manufacture), a wafer is manufactured using ingredients, such as silicon. Step 4 (wafer process) is called a before process, and forms a actual circuit on a wafer with a lithography technique using an above-mentioned mask and an above-mentioned wafer. The following step 5 (assembly) is called an after process, is a process semiconductor-chip-ized using the wafer produced by step 4, and contains like assemblers, such as an assembly process (dicing, bonding) and a packaging process (chip enclosure). At step 6 (inspection), the check test of the semiconductor device produced at step 5 of operation, an endurance test, etc. are inspected. A semiconductor device is completed through such a process and this is shipped (step 7).
[0034] Drawing 9 shows the detailed flow of the above-mentioned wafer process. The front face of a wafer is oxidized at step 11 (oxidation). At step 12 (CVD), an insulator layer is formed on a wafer front face. At step 13 (electrode formation), an electrode is formed by vacuum

evaporationo on a wafer. Ion is driven into a wafer at step 14 (ion implantation). A sensitization agent is applied to a wafer at step 15 (resist processing). At step 16 (exposure), a circuit pattern is imprinted to a wafer with the above-mentioned aligner. The exposed wafer is developed at step 17 (development). At step 18 (etching), parts other than the developed resist image are shaved off. The resist which etching could be managed with step 19 (resist exfoliation), and became unnecessary is removed. By carrying out by repeating these steps, a circuit pattern is formed on a wafer multiplex.

[0035]

[Effect of the Invention] As explained above, while realizing reduction of the exposure nonuniformity by equalization and high concentration maintenance of inert gas concentration distribution of an exposure field in the aligner exposed using the light of short wavelength according to this invention, exchange of maintenance and a maintenance, a photosensitive substrate, and a mask can be made easy.

[Translation done.]

* NOTICES *

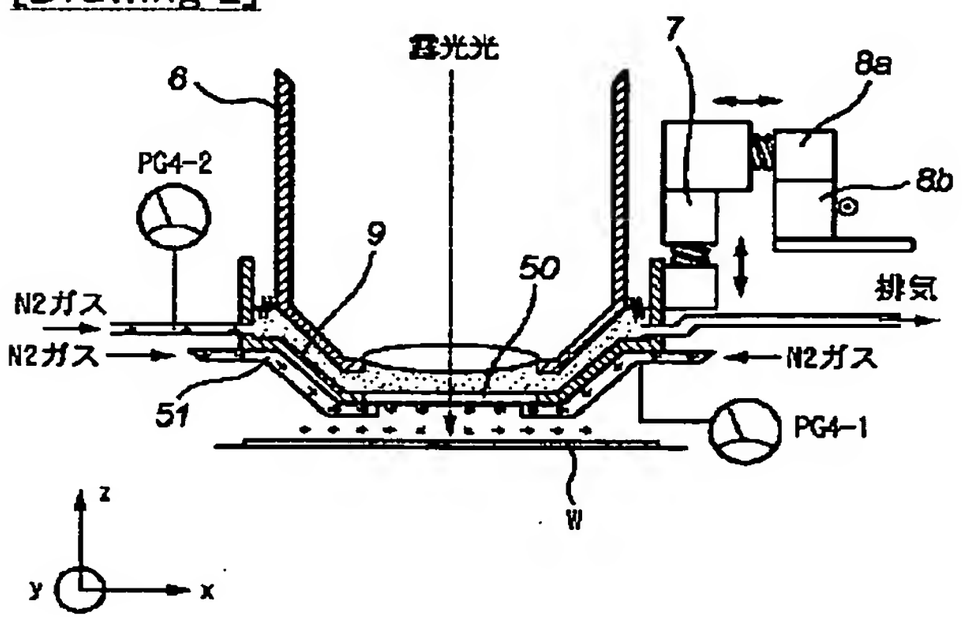
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the whole aligner block diagram of the 1st operation gestalt concerning this invention.
[Drawing 2] It is the sectional view showing the circumference of the projection optical system shown in drawing 1 , a covered member, and a photosensitive substrate.
[Drawing 3] It is the enlarged drawing of the projection optical system in the aligner of the 2nd operation gestalt concerning this invention.
[Drawing 4] It is the enlarged drawing of the projection optical system in the aligner of the 2nd operation gestalt concerning this invention.
[Drawing 5] It is the enlarged drawing of the projection optical system in the aligner of the 2nd operation gestalt concerning this invention.
[Drawing 6] It is drawing showing opening and the lighting region at the time of exposing the circumference of a photosensitive substrate in a scanning aligner.
[Drawing 7] It is the enlarged drawing of the projection optical system in the aligner of the 4th operation gestalt concerning this invention.
[Drawing 8] It is the flow chart which shows the overall manufacture process of a semiconductor device.
[Drawing 9] It is the flow chart which shows the detail of the wafer process of drawing 8 .
[Description of Notations]
1 Light Source
2 Light Source Control System
3 Stage Control System
4 Illumination-Light Study System
5 Reticle Stage Electric Shielding Member
6 Projection Optical System
7a, 7b, 7c, 7d Drive to the perpendicular direction of a covered member
8a, 8b, 8c, 8d Drive to the horizontal direction of a covered member
9, 72, 73 Covered member
10, 15, 16, 77 Optical member
11 Main Control System
14 Light Exposure Detector
30 Container Surrounding Aligner
50 Exposure Light Transmission Glass
52 Nitrogen Gas Supply Duct
Vo1, Vo2, Vo3, Vo4, Vo5 Exhaust air bulb
Vn1, Vn2, Vn3, Vn4, Vn5 Nitrogen supply bulb
71 Illumination-Light Study System
74 75 Exhaust port

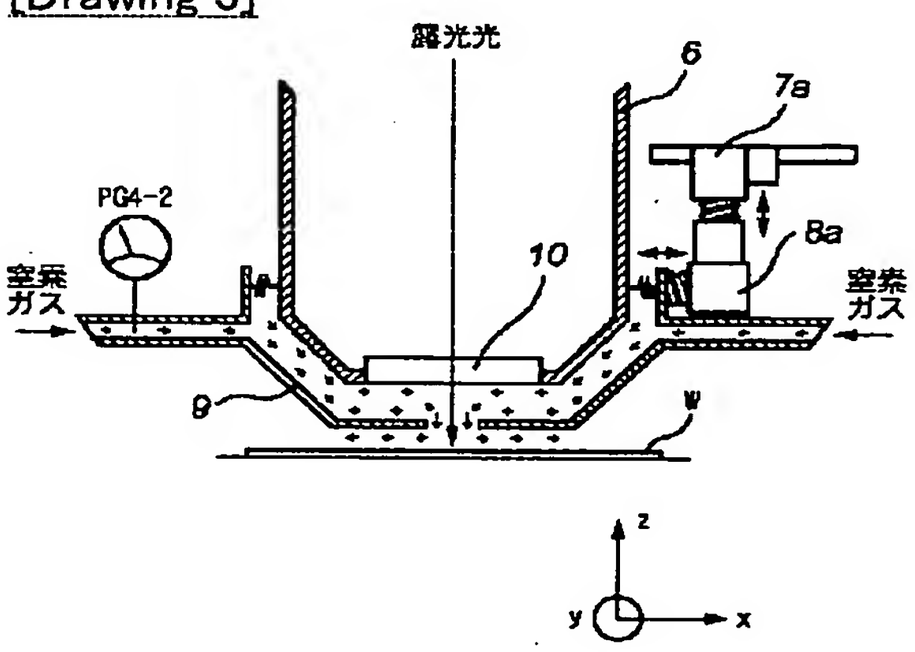
[Translation done.]

DRAWINGS

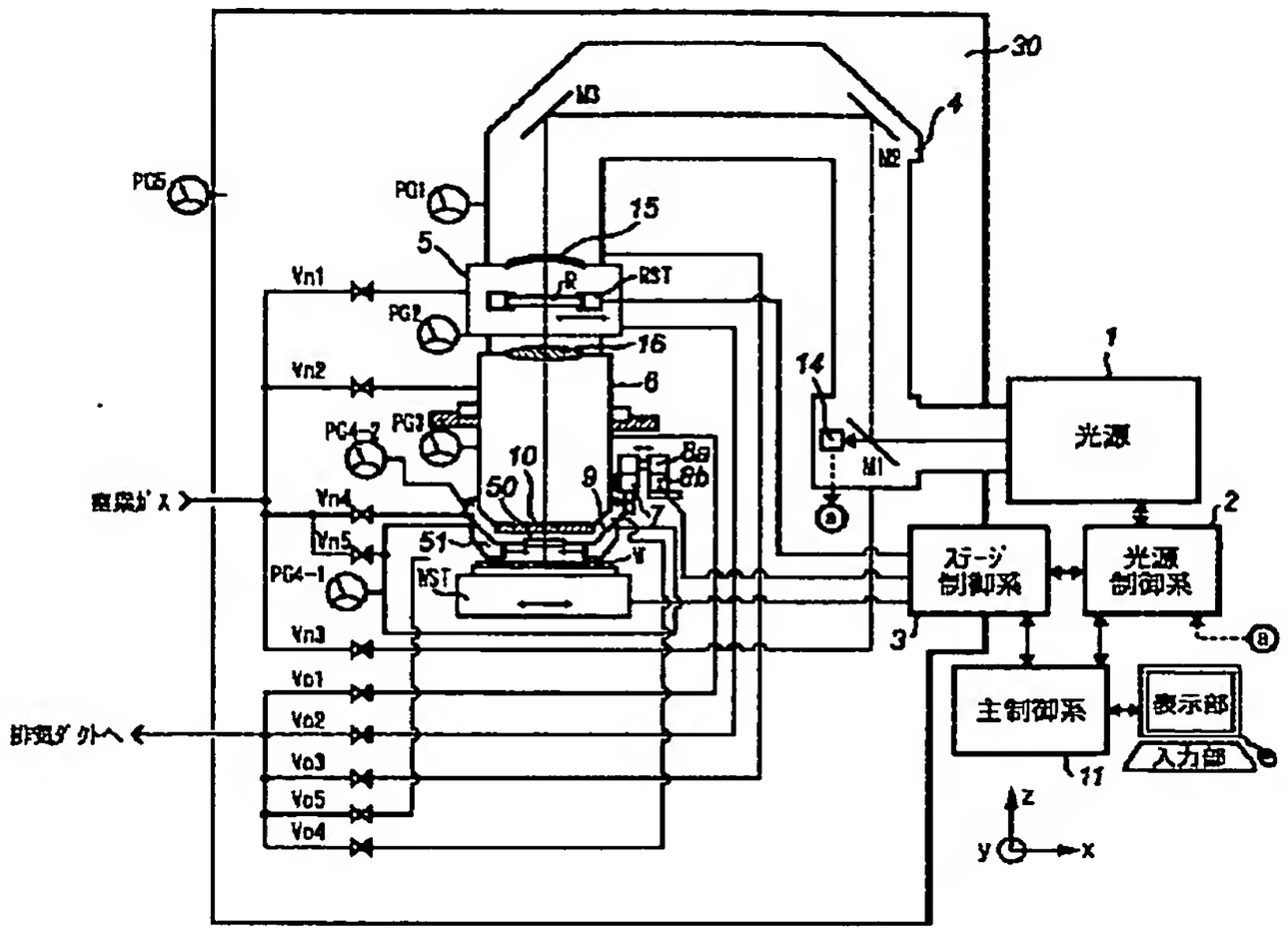
[Drawing 2]



[Drawing 3]



[Drawing 1]



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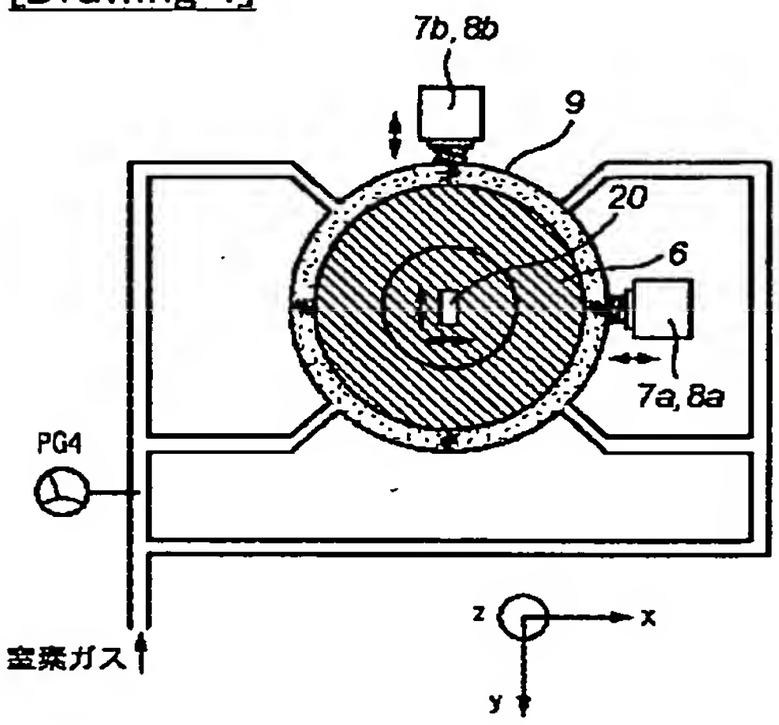
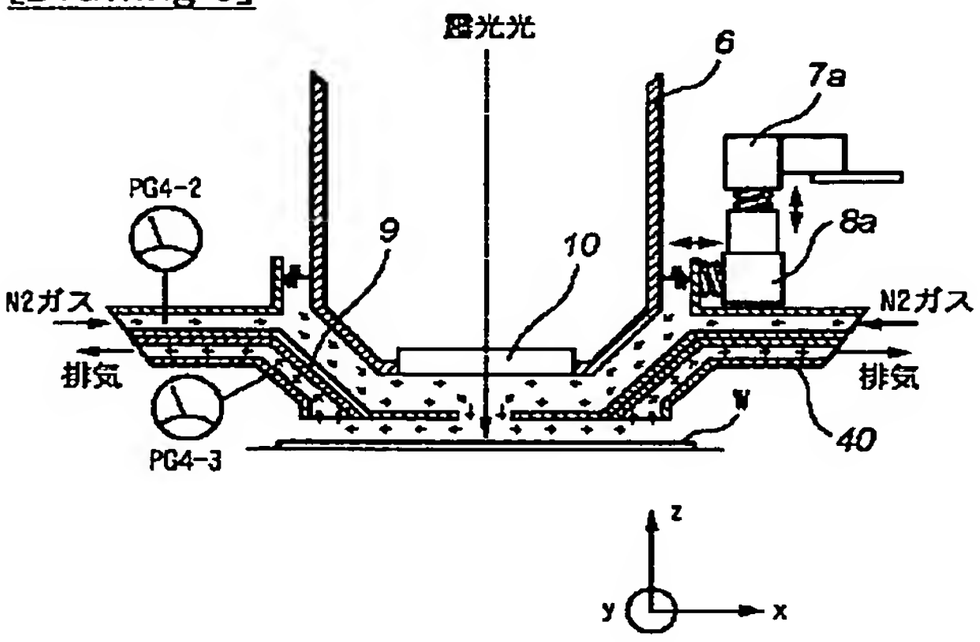
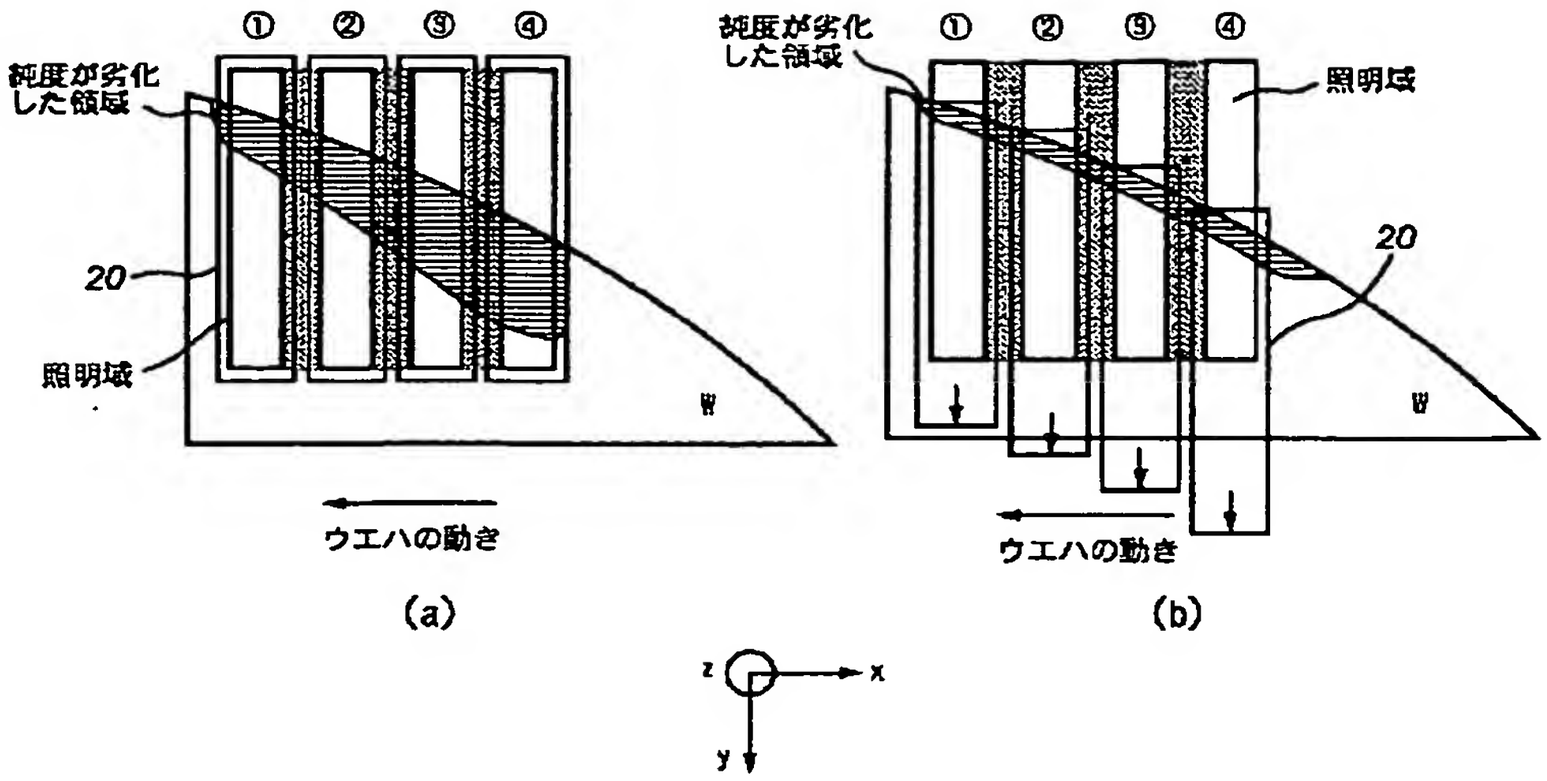


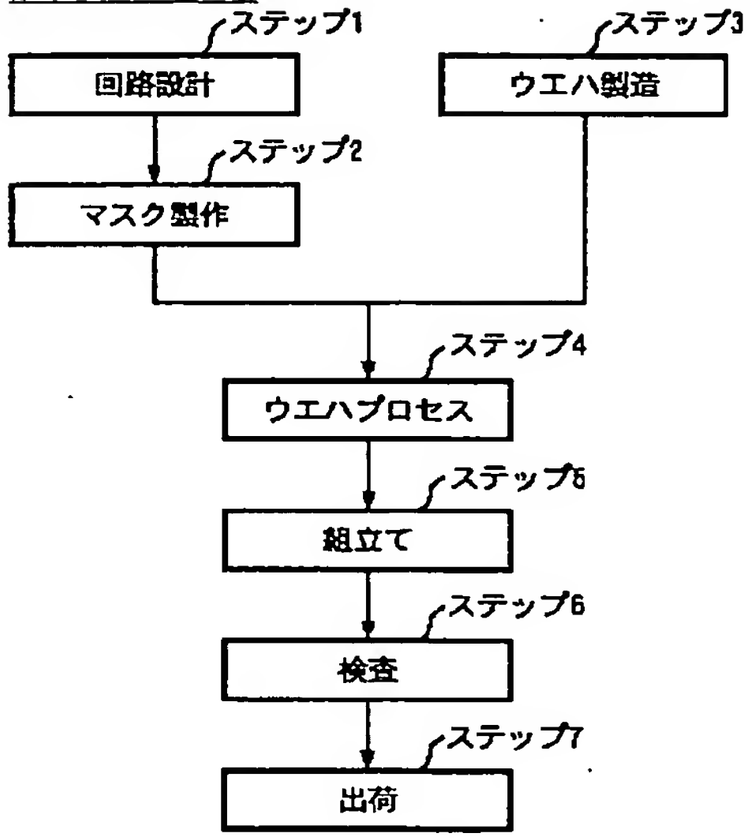
[Drawing 5]



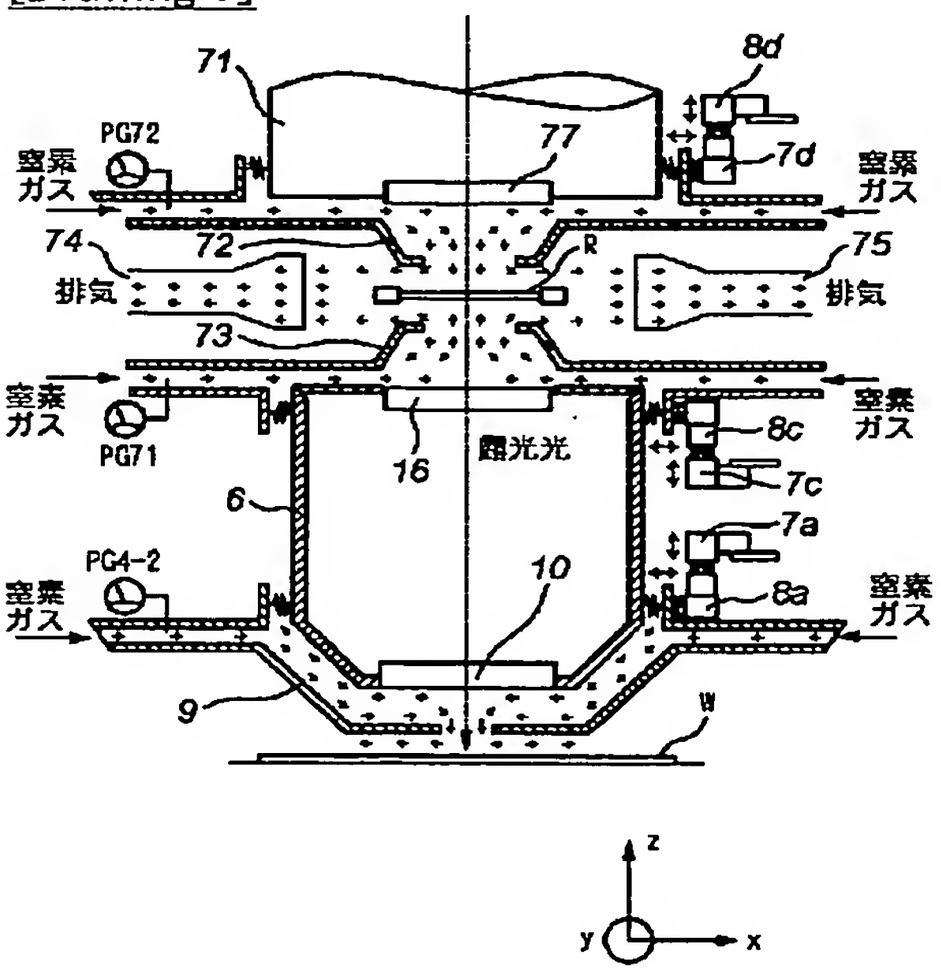
[Drawing 6]



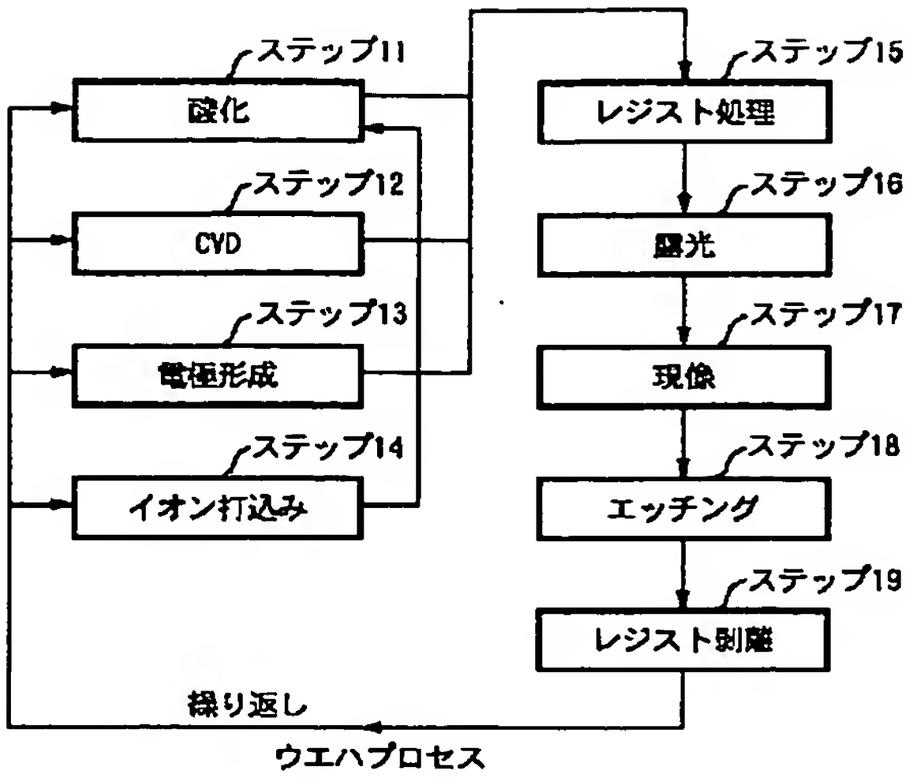
[Drawing 8]



[Drawing 7]



[Drawing 9]



[Translation done.]

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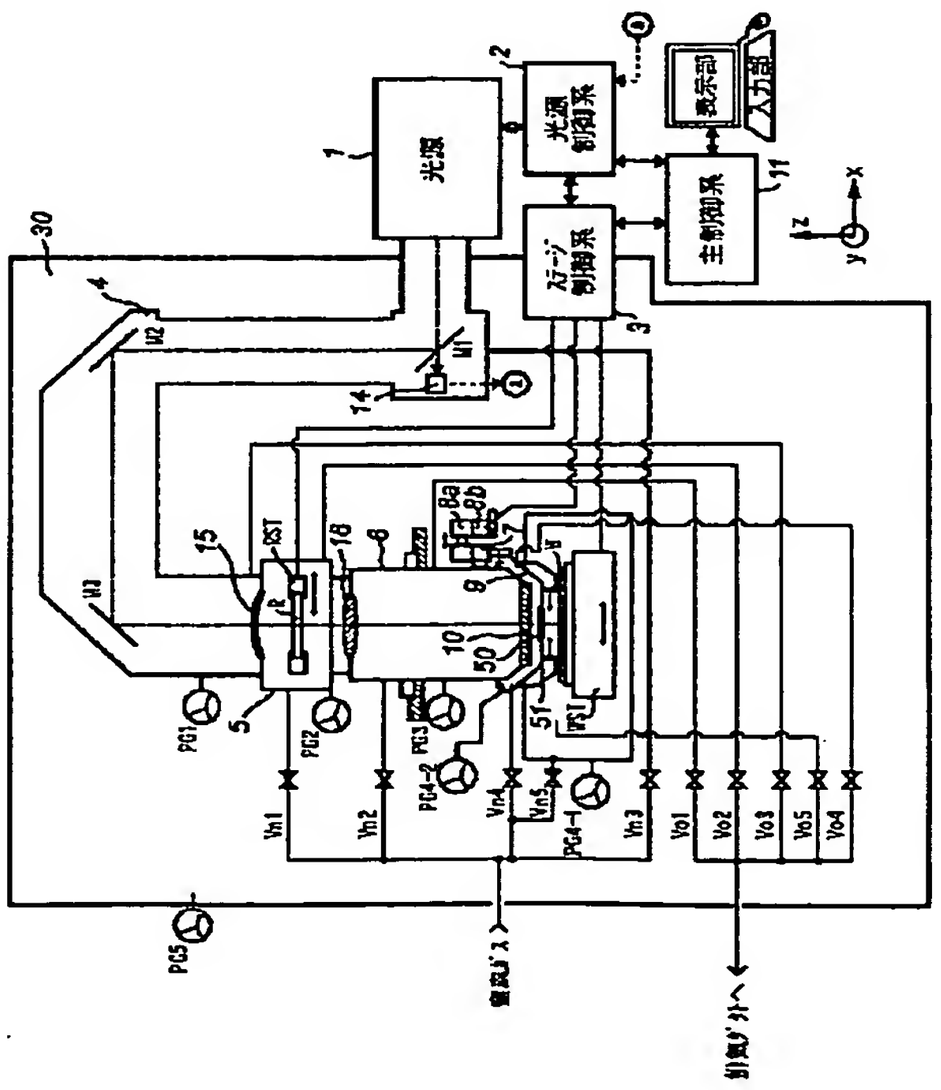
(54)【発明の名称】　露光装置

(57)【要約】
【課題】投影光学系と感光性基板間の露光光の強度低下を抑制し、且つ、その間の気体の濃度の不均一性を最低限に抑える。
【解決手段】投影光学系6とウエハWとの間の空間には、投影光学系6からウエハWの近傍までの露光光の光路のほぼ全域を外部雰囲気から遮蔽する遮蔽部材9が設けられている。遮蔽部材9は投影光学系6に取り付けられ、ウエハWの水平方向に駆動することが可能な駆動機構8ａ，８ｂおよび垂直方向に駆動することが可能な駆動機構７ａ，７ｂが設けられている。



【特許請求の範囲】
【請求項１】　マスクパターンの投影像を露光光により感光性基板に転写する露光装置であって、
前記露光光の光路に配設された光学部材周辺を取り囲み、当該光学部材周辺の雰囲気を高濃度の気体に置換し所定濃度に保持する遮蔽部材を有する露光装置において、前記光学部材に対して水平方向及び垂直方向の少なくともどちらかに移動可能な駆動機構を前記遮蔽部材に設けたことを特徴とする露光装置。
【請求項２】　前記マスクパターンを投影した露光光の光路を形成する投影光学系を更に含み、前記遮蔽部材は当該投影光学系から前記感光性基板への露光光の出射部分に配設された光学部材周辺を取り囲むように設けられることを特徴とする請求項1 に記載の露光装置。
【請求項３】　前記マスクパターンを投影した露光光の光路を形成する投影光学系を更に含み、前記遮蔽部材は当該投影光学系への露光光の入射部分に配設された光学部材周辺を取り囲むように設けられることを特徴とする請求項1 又は2 に記載の露光装置。
【請求項４】　前記投影光学系の前段に設けられ、マスクパターンを照明して投影像を生成する照明光の光路を形成する照明光学系を更に含み、前記遮蔽部材は当該照明光学系に保持されたマスクへの照明光の出射部分に配設された光学部材周辺を取り囲むように設けられることを特徴とする請求項2 又は3 に記載の露光装置。
【請求項５】　前記遮蔽部材は、不活性ガスを前記光学部材周辺に供給する供給部と、前記供給部から供給された不活性ガスを排出する排出部とを有することを特徴とする請求項1 乃至4 のいずれか1 項に記載の露光装置。
【請求項６】　前記遮蔽部材は露光光を透過する透明部材を有することを特徴とする請求項1 乃至5 のいずれか1 項に記載の露光装置。
【請求項７】　前記遮蔽部材は、当該遮蔽部材と前記感光性基板の間に不活性ガスを吹き付けることを特徴とする請求項1 乃至6 のいずれか1 項に記載の露光装置。
【請求項８】　前記遮蔽部材は、当該遮蔽部材と前記マスクの間に不活性ガスを吹き付けることを特徴とする請求項1 乃至6 のいずれか1 項に記載の露光装置。
【請求項９】　前記遮蔽部材は不活性ガスを通過させる開口を有し、前記投影光学系の光軸中心を通り且つ当該光軸中心に略平行な方向から前記感光性基板に不活性ガスを供給し、前記投影光学系は当該不活性ガス雰囲気中で露光光を出射することを特徴とする請求項1 乃至7 のいずれか1 項に記載の露光装置。
【請求項１０】　前記遮蔽部材は不活性ガスを通過させる開口を有し、前記照明光学系の光軸中心を通り且つ当該光軸中心に略平行な方向から前記マスクに不活性ガスを供給し、前記照明光学系は当該不活性ガス雰囲気中で照明光を出射することを特徴とする請求項1 乃至7 のいずれか1 項に記載の露光装置。
【請求項１１】　前記供給部は、前記遮蔽部材へ供給される不活性ガス流量を測定し、所定流量以上の不活性ガスを供給することを特徴とする請求項5 に記載の露光装置。
【請求項１２】　前記投影光学系と前記遮蔽部材との間の空間の圧力を、前記感光性基板と前記遮蔽部材の空間の圧力よりも高くする圧力調整部を更に備え、当該設定された圧力で前記感光性基板へ不活性ガスを供給することを特徴とする請求項1 乃至1１ のいずれか1 項に記載の露光装置。
【請求項１３】　前記照明光学系と前記遮蔽部材との間の空間の圧力を、前記マスクと前記遮蔽部材の空間の圧力よりも高くする圧力調整部を更に備え、当該設定された圧力で前記マスクへ不活性ガスを供給することを特徴とする請求項1 乃至1１ のいずれか1 項に記載の露光装置。
【請求項１４】　前記遮蔽部材と前記感光性基板の空間から不活性ガスを排気する排気部を更に備え、当該感光性基板と前記遮蔽部材の空間の圧力が前記投影光学系と前記遮蔽部材との間の空間の圧力よりも低い状態で、前記感光性基板へ不活性ガスが供給されることを特徴とする請求項１２ に記載の露光装置。
【請求項1.5】　前記遮蔽部材と前記マスクの空間から不活性ガスを排気する排気部を更に備え、当該マスクと前記遮蔽部材の空間の圧力が前記照明光学系と前記遮蔽部材との間の空間の圧力よりも低い状態で、前記マスクへ不活性ガスが供給されることを特徴とする請求項１３ に記載の露光装置。
【請求項１６】　前記遮蔽部材は、当該遮蔽部材と前記感光性基板との距離を所定距離に保持され、前記投影光学系から当該感光性基板までの前記不活性ガスの濃度を所定濃度に保持することを特徴とする請求項1 乃至1５ のいずれか1 項に記載の露光装置。
【請求項１７】　前記遮蔽部材と前記感光性基板との距離を測定する測定部を更に備え、当該測定部の測定結果に基づいて前記遮蔽部材と前記感光性基板との距離が所定距離に保持されて露光が行われることを特徴とする請求項1 乃至１６ のいずれか1 項に記載の露光装置。
【請求項１８】　前記遮蔽部材と前記マスクとの距離を測定する測定部を更に備え、当該測定部の測定結果に基づいて前記遮蔽部材と前記マスクとの距離が所定距離に保持されて露光が行われることを特徴とする請求項1 乃至１６ のいずれか1 項に記載の露光装置。
【請求項１９】　前記露光時に、前記投影光学系の遮蔽部材の開口は前記感光性基板に沿って水平に移動されることを特徴とする請求項1 乃至１８ のいずれか1 項に記載の露光装置。
【請求項２０】　前記遮蔽部材は、前記感光性基板及び／又はマスクの交換時や保守メンテナンス時に当該感光性基板及び／又はマスクからの距離を大きく離間させる

ように移動されることを特徴とする請求項1 乃至１９のいずれか1 項に記載の露光装置。
【請求項２１】 前記供給される不活性ガスは温度調節された窒素ガス又はヘリウムガスであることを特徴とする請求項1 乃至２０のいずれか1 項に記載の露光装置。
【請求項２２】 請求項1 乃至２１のいずれか1 項に記載の露光装置を含む各種プロセス用の製造装置群を半導体製造工場に設置する工程と、該製造装置群を用いて複数のプロセスによって半導体デバイスを製造する工程とを有することを特徴とする半導体デバイスの製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、例えば半導体素子、撮像素子、液晶表示素子、薄膜磁気ヘッド、その他のマイクロデバイスを製造するために用いられる露光装置に関し、詳しくは、短波長の光を用いて露光を行う露光装置において露光光の強度低下を抑制する露光装置に関する。
【０００２】
【従来の技術】半導体素子などを製造するためのフォトリソグラフィ工程において、フォトレチクル(レチクル含む)のパターン像を投影光学系を介して感光性基板上に露光する露光装置が使用されている。近年、半導体集積回路は、微細化の方向で開発が進み、フォトリソグラフィ工程においては、フォトリソグラフィ光源の短波長化が進んでいる。
【０００３】しかしながら、真空紫外線、特に２５０ｎｍよりも短い波長の光、たとえばＫｒＦエキシマレーザ(波長２４８ｎｍ)、ＡｒＦエキシマレーザ(波長１９３ｎｍ)、F_2レーザ(波長１５７ｎｍ)、またはＹＡＧレーザなどの高調波などの光を露光光として用いる場合、酸素による吸収などの影響で、光の強度が低下するなどの課題が生じていた。
【０００４】そこで、従来では、F_2エキシマレーザのような光源を有する露光装置において、光路部分のみを遮蔽し、たとえば窒素のような酸素を含まない気体に内部のガスを置換し、光の透過率の低下を回避しようとしていた。
【０００５】
【発明が解決しようとする課題】しかしながら、光路部分のみの遮蔽は、いわゆるステップ・アンド・リピート(ステップ毎に一括露光を繰り返す)方式の露光装置などのようにウエハステージやレチクルステージなどの可動部が光路中に存在する装置では困難であり、部分的に露光光が空気に曝されることは避けられなかった。
【０００６】また、感光性基板のステージを容器で包囲することなく、投影光学系から感光性基板への露光光の出射部分に配設された光学部材と感光性基板との間の空間に不活性ガスを供給することによって形成された所要の不活性ガス雰囲気中で露光することのできる露光装置においても、露光領域周辺から不活性ガスを供給するために、露光中心と周辺で不活性ガスの濃度分布が不均一になり、露光領域の雰囲気の透過率が不均一になることで均一な露光が困難であった。また、上記投影光学系の光学部材と感光性基板との間に不活性ガスを供給する供給部を取り付けることは、光学部材から感応性基板までの空間における保守作業を困難にしていた。
【０００７】本発明は、上記課題に鑑みてなされ、その目的は、短波長の光を用いて露光する露光装置において、露光光の光路に配設された光学部材周辺における露光光の強度低下を抑制し、且つ、その濃度分布の不均一性を最低限に抑えることができ、且つ光学部材と感光性基板又はマスクの空間の保守作業を容易にできる露光装置を提供することである。
【０００８】
【課題を解決するための手段】上述の課題を解決し、目的を達成するために、本発明の露光装置は、マスクパターンの投影像を露光光により感光性基板に転写する露光装置であって、前記露光光の光路に配設された光学部材周辺を取り囲み、当該光学部材周辺の雰囲気を高濃度の気体に置換し所定濃度に保持する遮蔽部材を有する露光装置において、前記光学部材に対して水平方向及び垂直方向の少なくともどちらかに移動可能な駆動機構を前記遮蔽部材に設けた。
【０００９】
【発明の実施の形態】以下に、本発明に係る実施の形態について、添付図面を参照して詳細に説明する。
[第1 実施形態] 図1 は、本発明に係る第1 実施形態の露光装置の全体構成図であり、図2 は、図1 に示す投影光学系、遮蔽部材、感光性基板の周辺を示す断面図である。
【００１０】図1 に示す露光装置は、例えばF_2エキシマレーザのような短波長レーザ光を射出する光源1 を備える。
【００１１】光源1 から発した光ビームの一部は、ビームスプリッタM1 を透過し、露光量検出器１４で光量が測定される。光源制御系2 は、露光量検出器１４の測定結果に基づいて光源1 の光量制御を行う。ビームスプリッタM1 で反射された光ビームはミラーM2、M3 で反射され、適当な光学部材１５を介してレチクルRを均一に照明する。光源1 からレチクルR に至る光路は照明光学系4 を構成している。レチクルRを透過した光は、投影光学系6 を構成する種々の光学部材１０，１６を介してウエハステージWSTに載置されたウエハWの表面上に到達し、レチクルR 上のパターンを結像する。
【００１２】ウエハWは、３次元方向(ＸＹＺ方向)に移動可能なウエハステージWST上に載置され、ステッピング移動される。そして、ウエハWは、ステッピング移動と露光とが繰り返し行われて、所謂ステップ・アンド・リピート方式で、ウエハW上にレチクルRのパター

ンが逐次投影露光される。
【００１３】主制御系は光源1、ウエハステージWSTのXY方向の移動、レチクルステージRSTの移動等を統括的に制御する。
【００１４】光源1から投影光学系6の露光光をウエハWに出射する光学部材１０までの露光光の光路は遮蔽部材5によって遮蔽され、照明光学系４、遮蔽部材5、投影光学系6はバルブVn１，Vn２，Vn３を介して温度調節された不活性ガス、例えば、窒素ガスが供給され、バルブVo１，Vo２，Vo３により排気される。
【００１５】投影光学系6とウエハWとの間の空間には、投影光学系6からウエハWの近傍までの露光光の光路のほぼ全域を外部雰囲気から遮蔽する遮蔽部材9が設けられている。
【００１６】図2に投影光学系を拡大して示すように、遮蔽部材9は投影光学系6に取り付けられ、ウエハWの水平方向に駆動することが可能な駆動機構8a，８bおよび垂直方向に駆動することが可能な駆動機構7が設けられている。また、遮蔽部材9と投影光学系6の接合部分は蛇腹状の部品で接合されその位置関係が変化しても、遮蔽部材9と投影光学系6が密着した状態を維持できる構造とする。
【００１７】遮蔽部材9は露光光を通過させるための硝子５０を有している。また、遮蔽部材9により取り囲まれた空間にはバルブVn４を介して温度調節された窒素ガスが供給される。遮蔽された空間の圧力は圧力計PG4-2で測定される。Vn４を介して供給された窒素ガスは、遮蔽部材9内部を満たし、バルブVo４を介して排気される。
【００１８】温度調節された窒素ガスは、バルブVn５を介して遮蔽部材9とウエハW面との間に供給される。供給された窒素ガスはバルブVo５を介して排気される。この時、バルブVo５で供給される窒素ガスの圧力は圧力系PG4-1で測定され、露光装置を格納する容器３０内の圧力は圧力計PG５で測定される。通常PG4-1の値がPG５以上になるように調整されている。
【００１９】遮蔽部材9に取り付けた駆動機構7，８a，８bにより水平方向及び垂直方向に駆動される。ウエハ交換や保守メンテナンス時には遮蔽部材9をZ軸プラス方向に駆動することでウエハWから離間させ、ウエハ交換や保守メンテナンス作業を容易にする。そして、ウエハ交換後など露光開始時には、まず、遮蔽部材をZ軸プラス方向に移動させた状態、すなわち、遮蔽部材9と投影光学系6で囲まれた空間をできるだけ狭くした状態で、バルブVn４を介して温度調節された窒素ガスの供給を開始する。これにより、遮蔽部材9と投影光学系6で囲まれた空間の不活性ガス濃度を短時間で高濃度にすることが可能である。次に、所定の圧力を維持しつつ、遮蔽部材9をウエハWから所定の高さの位置までZ軸マイナス方向に駆動し、ウエハW、レチクルRのアライメントを行いつつ露光を行う。この場合、遮蔽部材9とウエハWの間の距離を例えば1ｍｍに配置することで、投影光学系6の周辺からの雰囲気が侵入することによる露光領域の不活性ガス濃度の低下を抑え、均一な濃度分布を得ることが可能である。また、ウエハステージWSTとレチクルステージRSTに同期して、遮蔽部材9とウエハW間の距離を測定し、その間の距離を一定に保ちつつ露光を行うことで、より均一な濃度分布を得ることが可能である。
[第2実施形態] 図3乃至図5は本発明に係る第2実施形態の露光装置における投影光学系の拡大図である。
【００２０】第1実施形態では遮蔽部材9に露光光を透過する硝子５０を使用し、ウエハWと硝子５０の間の空間に温度調節された窒素ガスを供給することで、露光領域の窒素ガス濃度の低下を抑え、均一な濃度分布を得ることができた。
【００２１】この第1実施形態に対して、第2実施形態では、図3乃至図5に示すように、投影光学系6に取り付けられた遮蔽部材9のウエハWに対向する部位に開口２０を設け、開口２０から露光光を通過させると共に、その開口２０からウエハWに温度調節された窒素ガスを供給することで、露光領域の窒素ガス濃度の低下を抑え、均一な濃度分布を得るものである。
【００２２】第1実施形態と同様に、遮蔽部材9に取り付けた駆動機構7ａ，７ｂ，８ａ，８ｂにより水平方向及び垂直方向に駆動される。ウエハ交換や保守メンテナンス時には遮蔽部材9をZ軸プラス方向に駆動することでウエハWから離間させ、ウエハ交換や保守メンテナンス作業を容易にする。そして、ウエハ交換後など露光開始時には、まず、遮蔽部材9をZ軸プラス方向に移動させた状態、すなわち、遮蔽部材9と投影光学系6で囲まれた空間をできるだけ狭くした状態で、バルブVn４を介して温度調節された窒素ガスの供給を開始する。これにより、遮蔽部材9と投影光学系6で囲まれた空間の不活性ガス濃度を短時間で高濃度にすることが可能である。次に、所定の圧力を維持しつつ、遮蔽部材9をウエハWから所定の高さの位置までZ軸マイナス方向に駆動し、ウエハW、レチクルRのアライメントを行いつつ、ウエハステージとレチクルステージに同期して、遮蔽部材9とウエハW間の距離を測定し、その間の距離を一定に保ちつつ露光を行うことで、より均一な濃度分布を得ることが可能である。
【００２３】また、図5に示すように遮蔽部材9を遮蔽部材9の外側に排気口４０を設けることで開口２０からウエハWと遮蔽部材9の間に供給した窒素ガスを効率良く回収しても良い。この時、排気口４０の圧力をPG4-3で測定し、遮蔽部材9で囲まれた空間の圧力PG4-2よりも、PG4-3の圧力が低くなるように排気量を制御することでも、遮蔽部材9から開口２０を通過してウエハ面上に窒素ガスを供給することが可能である。

[第3 実施形態] 図6 は走査型露光装置において感光性基板の周辺を露光する際の開口と照明域を示す図である。

【００２４】以下に、本発明の露光装置を第3 実施形態として走査型露光装置に適用し、ウエハWの周辺を露光する場合の遮蔽部材9 の駆動方法について説明する。

【００２５】図6（ａ）に示すように、ウエハWの周辺を露光する場合、①～④の領域を順次露光することになる。この場合、照明光が照射される照明域と遮蔽部材9 に設けた開口２０の位置はそれぞれの中心が一致するように配置されているために、開口２０の一部がウエハWの外側に出ることになる。この場合、ウエハWと周辺の段差から周辺の雰囲気の拡散とステージの駆動時の巻き込みにより、露光領域であり且つウエハ面上に存在する領域の窒素ガス濃度を低下させることになる。窒素ガス濃度が低下した部分に関しては透過率が低下するために、露光光量不足になり、露光ムラを生じる。そこで、開口２０を図6（ｂ）に示すように、ウエハ周辺に沿って遮蔽部材9 をy 方向にウエハステージ及びレチクルステージに同期させつつ駆動する。このように駆動させることで、開口２０をウエハWの内側に配置することができ、ウエハWとその周辺の段差から周辺の雰囲気の侵入を抑え、均一な濃度分布をより広い空間で達成することが可能である。

【００２６】上記と同様なことがステップ・アンド・リピート 方式の露光装置においても適用可能である。また、開口の大きさを変える機構を追加することで、ウエハWの周辺を露光する際には開口の大きさを小さくすることになり、遮蔽部材内部に供給する窒素の消費量が同じ場合には開口が小さい場合のほうが開口から噴出する窒素の流速が大きくなるので、より開口部の窒素濃度の劣化を抑えることが可能となる。

[第4 実施形態] 図7 は本発明に係る第4 実施形態の露光装置における投影光学系の拡大図である。

【００２７】上記各実施形態では、レチクルR 周辺を密閉空間にしていたが、この第4 実施形態ではレチクル側にも遮蔽部材７２，７３を使用し、露光光が通過する部分に開口を設け、各開口から温度調節された窒素ガスをレチクルR に向かって吹き付ける。

【００２８】遮蔽部材７２は、照明光学系7 の照明光を照明する光学部材７７を覆うように照明光学系７１に取り付けられ、接合部分は蛇腹状の部品で接合されその位置関係が変化しても、遮蔽部材７２と照明光学系７１とが密着した状態を維持できる構造とする。同じく、遮蔽部材７３は照明光学系７１の照明光を入射する光学部材１６を覆うように投影光学系6 に取り付けられ、接合部分は蛇腹状の部品で接合されその位置関係が変化しても、遮蔽部材７３と投影光学系6が密着した状態を維持できる構造とする。

【００２９】前記遮蔽部材７２，７３はレチクルR に対して水平方向及び垂直方向に駆動される駆動機構７ｃ，７ｄ，８ｃ，８ｄを有し、レチクル交換や保守メンテナンス時には遮蔽部材７２，７３をレチクルRから離間させる方向へ駆動することで、レチクル交換や保守メンテナンス作業を容易にする。そして、レチクル交換後など露光開始時には、まず、遮蔽部材７２，７３をレチクルRから離れるようＺ軸プラス或いはマイナス方向に移動させた状態、すなわち、遮蔽部材７２と照明光学系７１で囲まれた空間をできるだけ狭くした状態で、温度調節された窒素ガスの供給を開始する。これにより、遮蔽部材７３と照明光学系７１で囲まれた空間の不活性ガス濃度を短時間で高濃度にすることが可能である。同様に、遮蔽部材７３と投影光学系6 で囲まれた空間をできるだけ狭くした状態で、温度調節された窒素ガスの供給を開始する。これにより、遮蔽部材７３と投影光学系6 で囲まれた空間の不活性ガス濃度を短時間で高濃度にすることが可能である。次に、所定の圧力を維持しつつ、遮蔽部材７２，７３をレチクルRから所定の高さの位置までに駆動し、ウエハW、レチクルR のアライメントを行いつつ、ウエハステージとレチクルステージに同期して、遮蔽部材７２，７３とレチクルR 間の距離を測定し、その間の距離を一定に保ちつつ露光を行うことで、より均一な濃度分布を得ることが可能である。

【００３０】本実施形態では、窒素ガスの供給圧力はＰＧ７１，ＰＧ７２で測定し、所定の圧力を維持できるよう窒素ガスを供給する。また、遮蔽部材に給気口圧力を測定する測定部を設けているが、給気口に流量計を有し、流量計の値を一定にするよう給気口から窒素ガスを供給することで開口からレチクル面上に窒素ガスを供給しても良い。供給された窒素ガスは排気口７４，７５から回収される。また、排気口を第2 実施形態に示すように遮蔽部材を囲うように取り付けることで、供給した窒素ガスを効率良く回収しても良い。

【００３１】尚、以上説明した実施の形態は、本発明の実現手段としての一例であり、本発明は、その趣旨を逸脱しない範囲で上記実施形態を修正又は変形したものにも適用可能である。

【００３２】また、本実施形態の露光装置は、投影光学系の遮蔽部材9 と照明光学系の遮蔽部材７２，７３との少なくとも一方を設けて構成してもよい。

[製造プロセス] 次に、上記の露光装置を利用した半導体デバイスの製造プロセスを説明する。

【００３３】図8 は半導体デバイスの全体的な製造プロセスのフローを示す。ステップ1(回路設計) では半導体デバイスの回路設計を行なう。ステップ2(マスク作製) では設計した回路パターンに基づいてマスクを作製する。一方、ステップ3(ウエハ製造) ではシリコン等の材料を用いてウエハを製造する。ステップ4(ウエハプロセス) は前工程と呼ばれ、上記のマスクとウエハを用いて、リソグラフィ技術によってウエハ上に実際の回

路を形成する。次のステップ5(組み立て) は後工程と呼ばれ、ステップ4によって作製されたウエハを用いて半導体チップ化する工程であり、アッセンブリ工程(ダイシング、ボンディング) 、パッケージング工程(チップ封入) 等の組み立て工程を含む。ステップ6(検査) ではステップ5で作製された半導体デバイスの動作確認テスト、耐久性テスト等の検査を行なう。こうした工程を経て半導体デバイスが完成し、これを出荷(ステップ7) する。

【００３４】図9は上記ウエハプロセスの詳細なフローを示す。ステップ11(酸化) ではウエハの表面を酸化させる。ステップ12(ＣＶＤ) ではウエハ表面に絶縁膜を成膜する。ステップ13(電極形成) ではウエハ上に電極を蒸着によって形成する。ステップ14(イオン打込み) ではウエハにイオンを打ち込む。ステップ15(レジスト処理) ではウエハに感光剤を塗布する。ステップ16(露光) では上記の露光装置によって回路パターンをウエハに転写する。ステップ17(現像) では露光したウエハを現像する。ステップ18(エッチング) では現像したレジスト像以外の部分を削り取る。ステップ19(レジスト剥離) ではエッチングが済んで不要となったレジストを取り除く。これらのステップを繰り返し行なうことによって、ウエハ上に多重に回路パターンを形成する。

【００３５】

【発明の効果】以上説明したように、本発明によれば、短波長の光を用いて露光を行う露光装置において、露光領域の不活性ガス濃度分布の均一化と高濃度維持による露光ムラの低減を実現すると共に、保守・メンテナンスや感光性基板やマスクの交換を容易にできる。

【図面の簡単な説明】

【図1】本発明に係る第1 実施形態の露光装置の全体構成図である。

【図2】図1 に示す投影光学系、遮蔽部材、感光性基板の周辺を示す断面図である。

【図3】本発明に係る第2 実施形態の露光装置における投影光学系の拡大図である。

【図4】本発明に係る第2 実施形態の露光装置における投影光学系の拡大図である。

【図5】本発明に係る第2 実施形態の露光装置における投影光学系の拡大図である。

【図6】走査型露光装置において感光性基板の周辺を露光する際の開口と照明域を示す図である。

【図7】本発明に係る第4 実施形態の露光装置における投影光学系の拡大図である。

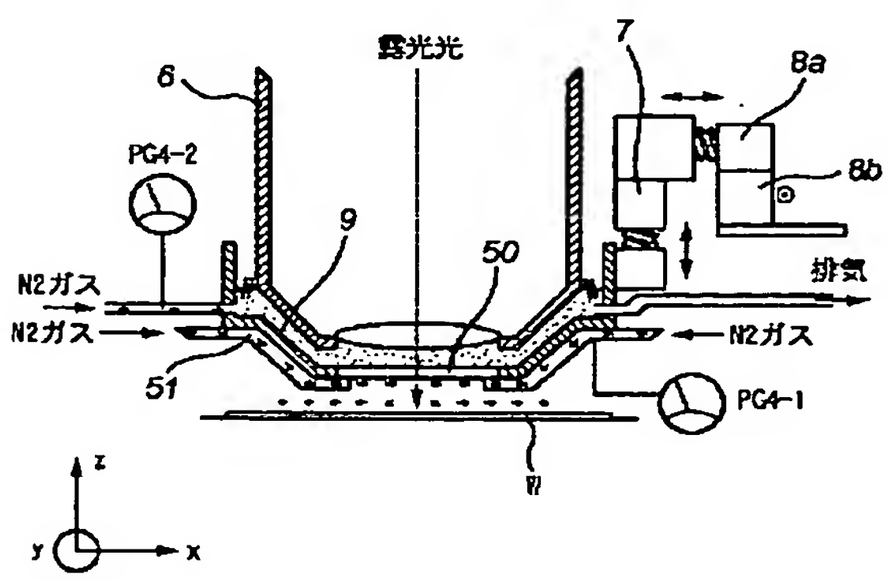
【図8】半導体デバイスの全体的な製造プロセスを示すフローチャートである。

【図9】図8 のウエハプロセスの詳細を示すフローチャートである。

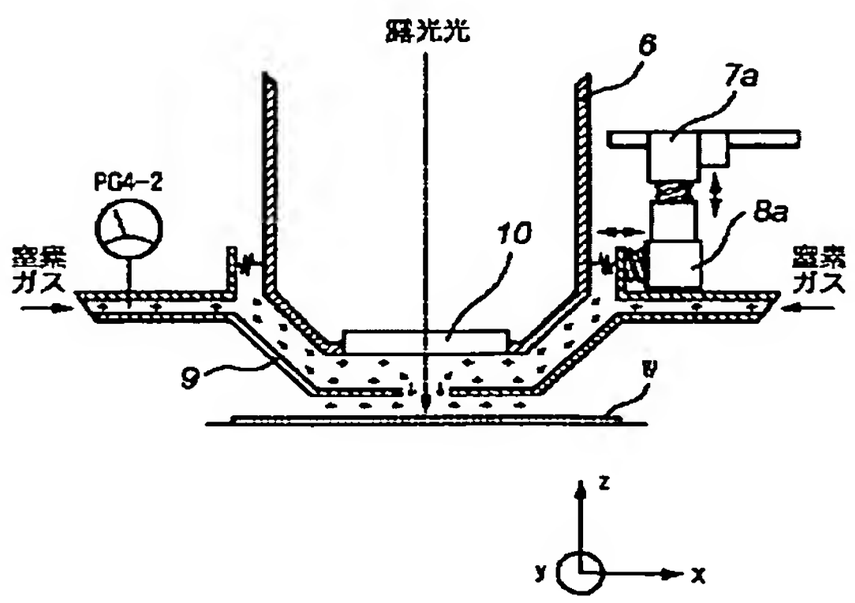
【符号の説明】

１　光源
２　光源制御系
３　ステージ制御系
４　照明光学系
５　レチクルステージ遮蔽部材
６　投影光学系
７ａ，７ｂ，７ｃ，７ｄ　遮蔽部材の垂直方向への駆動機構
８ａ，８ｂ，８ｃ，８ｄ　遮蔽部材の水平方向への駆動機構
９，７２，７３　遮蔽部材
１０，１５，１６，７７　光学部材
１１　主制御系
１４　露光量検出器
３０　露光装置を囲う容器
５０　露光光透過硝子
５２　窒素ガス給気ダクト
Ｖｏ１，Ｖｏ２，Ｖｏ３，Ｖｏ４，Ｖｏ５　排気バルブ
Ｖｎ１，Ｖｎ２，Ｖｎ３，Ｖｎ４，Ｖｎ５　窒素供給バルブ
７１　照明光学系
７４，７５　排気口

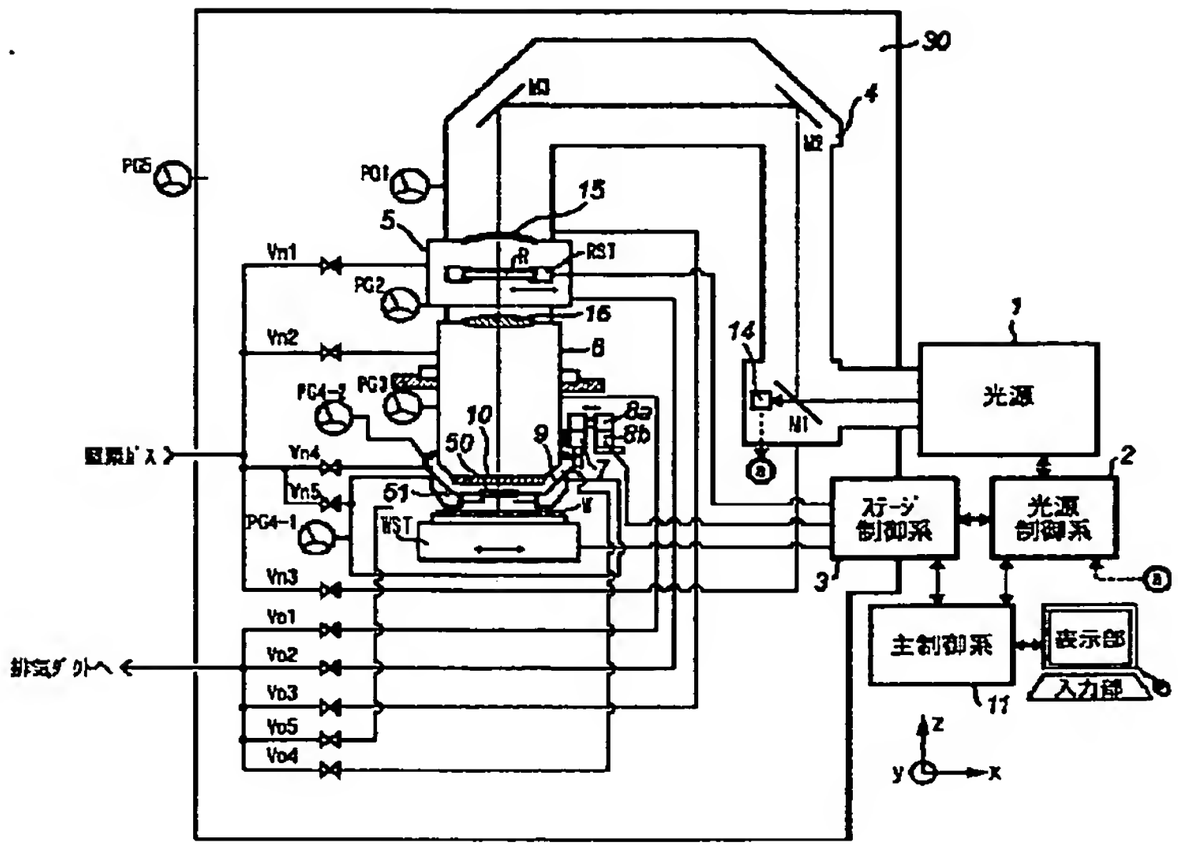
【図2】



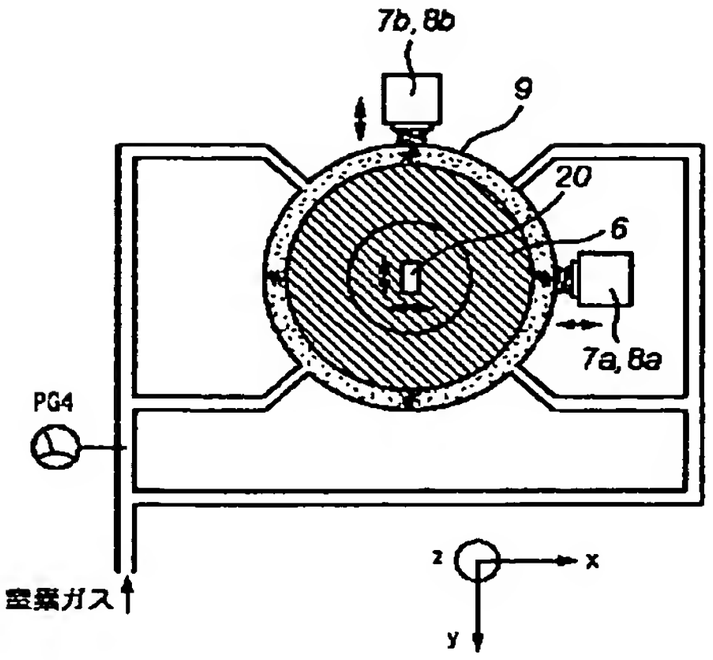
【図3】



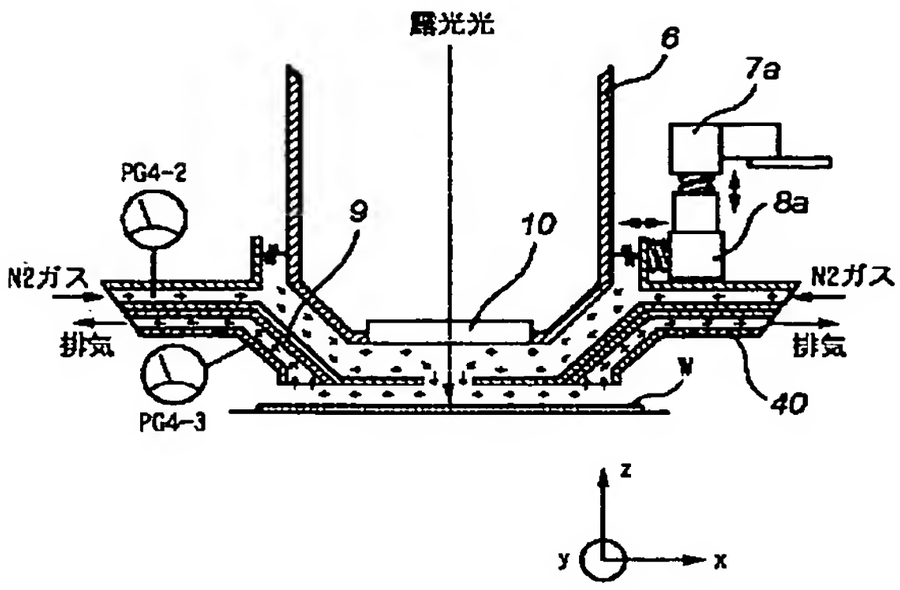
【 図1 】


30
M3
M2
4
PG5
PG1
15
5
Vn1
RST
PG2
16
Vn2
8
14
1
PG4-2
PG3
8a
8b
10
9
50
M1
光源
露光ガス
Vn4
7
2
Vn5
51
ステージ制御系
光源制御系
PG4-1
W
RST
3
Vn3
Vo1
主制御系
表示部
入力部
Vo2
11
排気ダクトへ
Vo3
Vo5
Vo4
z
y
x

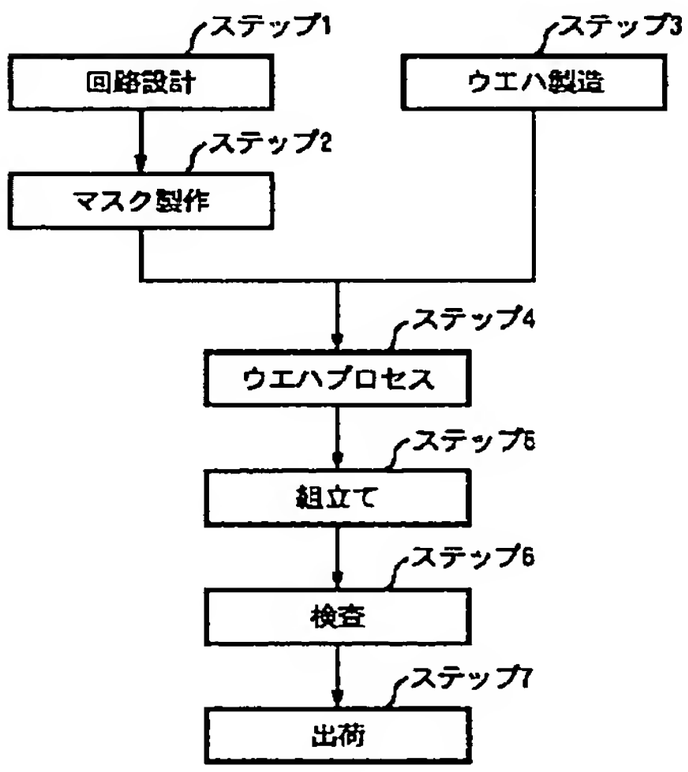
【 図4 】


7b, 8b
9
20
6
7a, 8a
PG4
窒素ガス
z
x
y

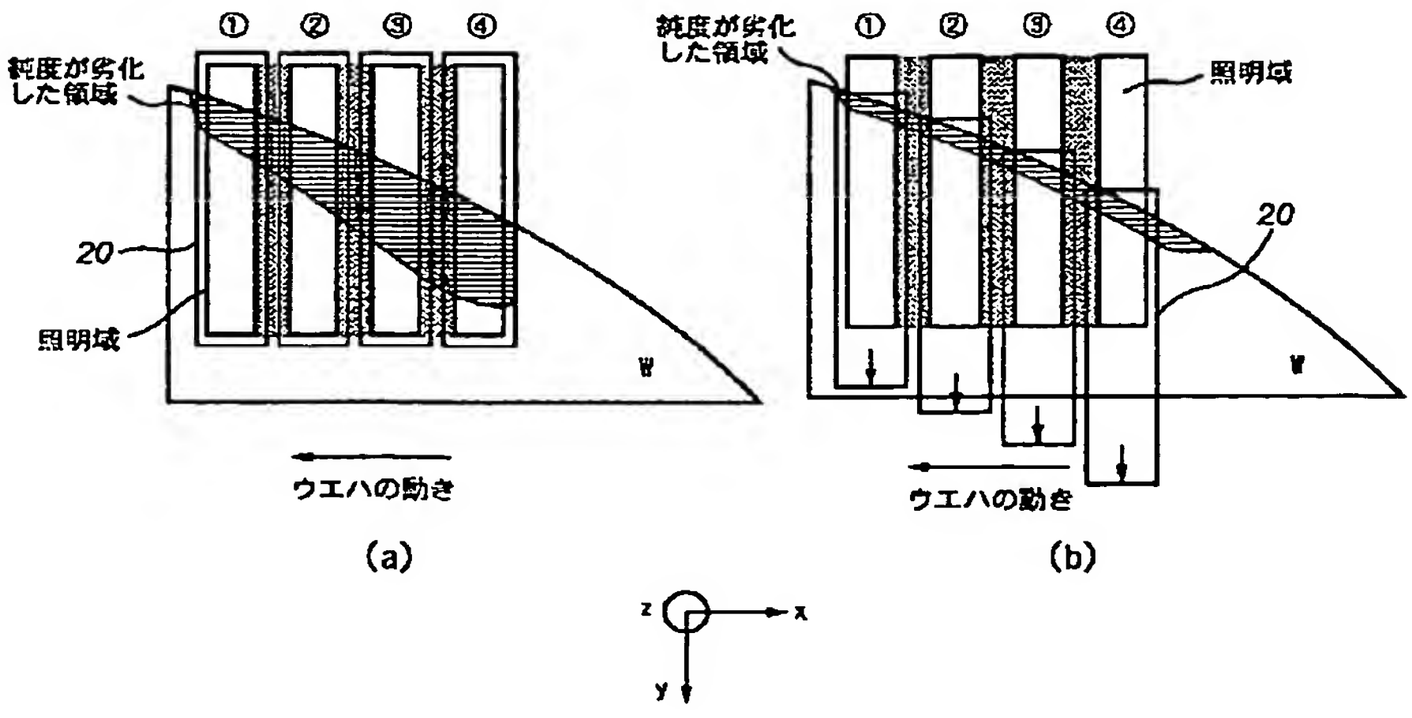
【 図5 】


露光光
6
7a
PG4-2
9
10
8a
N2ガス
N2ガス
排気
排気
W
40
PG4-3
z
y
x

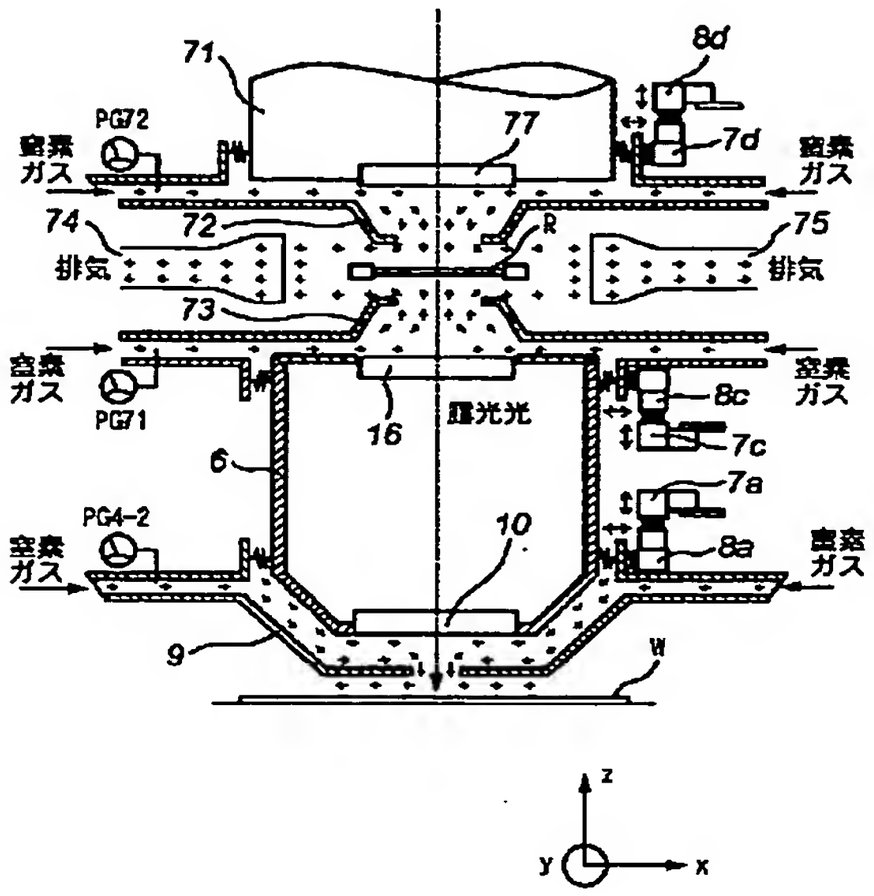
【 図8 】


ステップ1
回路設計
ステップ3
ウエハ製造
ステップ2
マスク製作
ステップ4
ウエハプロセス
ステップ5
組立て
ステップ6
検査
ステップ7
出荷

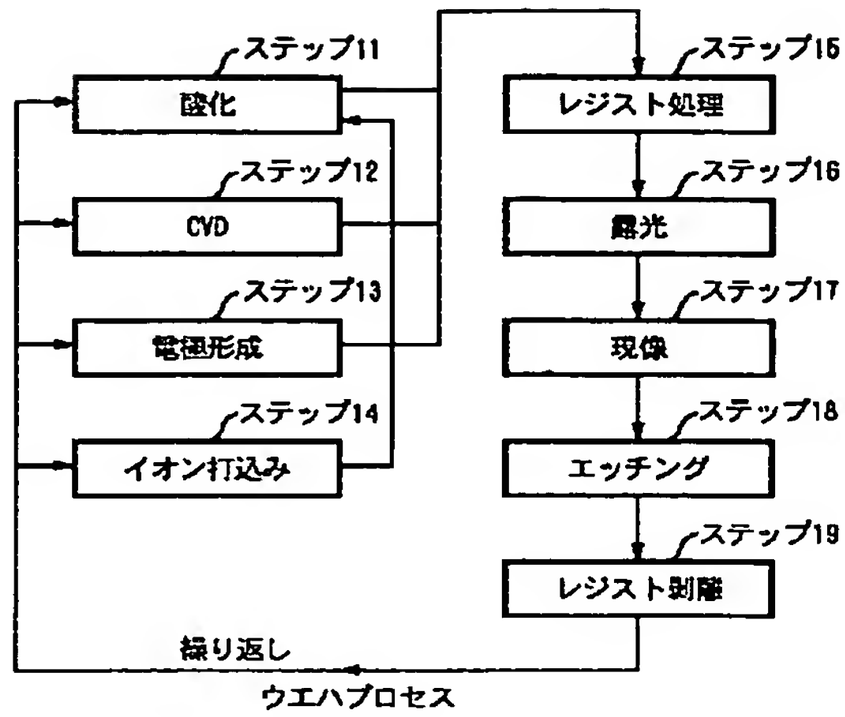
【 図6 】


①
②
③
④
純度が劣化した領域
20
照明域
W
ウエハの動き
(a)
純度が劣化した領域
①
②
③
④
照明域
20
W
ウエハの動き
(b)
z
x
y

【 図7 】


71
8d
PG72
窒素ガス
77
7d
窒素ガス
74
72
R
75
排気
排気
73
窒素ガス
PG71
窒素ガス
16
露光光
8c
7c
6
7a
PG4-2
窒素ガス
10
8a
窒素ガス
9
W
z
y
x

【 図9 】


ステップ11
酸化
ステップ12
CVD
ステップ13
電極形成
ステップ14
イオン打込み
ステップ15
レジスト処理
ステップ16
露光
ステップ17
現像
ステップ18
エッチング
ステップ19
レジスト剥離
繰り返し
ウエハプロセス